Modeling the 23 June 2001 Peru local tsunami using results from a quick seismic inversion of the earthquake

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Abstract. As detailed information about tsunamigenic earthquakes becomes more rapidly available, tsunami scientists are better able to estimate local tsunami amplitudes in a short amount of time. Though seismic inversion results are often revised as more data are received, this initial information provides critical input to model tsunami generation. It is a significant improvement over uniform slip dislocation models derived from a point-source characterization of the earthquake that typically underestimate the amplitude and frequency characteristics of the local tsunami (Geist and Dmowska, 1999). Seismic inversion results for the 23 June 2001 $M_w = 8.4$ Peru earthquake were posted on the internet within a day after the event (Kikuchi and Yamanaka, Earthquake Research Institute, Univ. Tokyo: http://wwweic.eri.u-tokyo.ac.jp/topics/200106232033/). The moment distribution for the main shock was inverted from P-waves recorded at 24 IRIS stations, using a technique modified from the original version described by Kikuchi and Kanamori (1991). Results from the inversion indicate that the largest moment release, and hence the primary tsunami source area, occurred 150 km southeast of the epicenter. The corresponding slip distribution is calculated using a regional, depth-dependent shear modulus function derived from source duration analysis of previous earthquakes in the region (Bilek and Lay, 1999). Coseismic vertical displacement is computed from superimposed displacement fields computed for each grid cell of the finite-rupture model. Because the rupture area straddles the coastline, only a portion of the vertical deformation from the earthquake was transferred to the tsunami. Inversion results from Kikuchi and Yamanaka also yield information about the spatial heterogeneity of rake (slip vector angle). Moderate variations in rake angle throughout the rupture zone for the Peru main shock have a measurable effect on the initial tsunami wavefield. Synthetic marigrams and peak nearshore tsunami amplitude (PNTA) are computed using a finite-difference approximation to the linear-long wave equations. Highest tsunami amplitudes are predicted to have occurred in the Camaná-Chala region of Peru, with a secondary peak in PNTA south of Iquique, Chile. The synthetic marigrams at most locations indicate that the highest amplitude waves occurred after the first arrival. Further analysis will include developing a finite-element model for tsunami generation that accounts for regional structural inhomogeneity (Yoshioka *et al.*, 1989). Indicative of possible future trends in tsunami research, preliminary analysis of the 23 June 2001 Peru tsunami highlights the importance of incorporating seismic inversion results into tsunami modeling efforts and the rapid transfer of results among different scientific disciplines through the internet.

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